THE ANTI-MALARIAL OPERATIONS AT ISMAILIA

BY

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That the Anti-malarial operations at Ismailia following on the report of Sir Ronald Ross (1903) have resulted in completely freeing the town from Anophelines and hence from malaria is a well-known fact, but I do not think it is equally well known what exactly was done at Ismailia to secure this result. I have attempted here to give as complete an account as possible; the only existing account so far being the brochure in French of the Suez Canal Company, of which I have made full use*†. I have thought it of interest also to attempt to trace historically the beginnings of malaria at Ismailia.

I. HISTORICAL

The history of malaria in the Isthmus of Suez and more particularly at Ismailia is bound up with the history of the water supply of the region. The problem of supplying water to the workmen engaged in cutting the Suez Canal through the desert, was always a pressing one in the early days of the construction. The three sources of water that were at successive periods available were, viz., (1) the wells, (2) the alimentary canal, and (3) the freshwater canal which flows from Cairo to Ismailia.

THE WELLS

1859. April 25. The work of constructing the Suez Canal was commenced.

1859-1860. Water was found at the following sites near Ismailia, the centre of the Isthmus.

* While this article was in the press a paper by Bruce (1911) has appeared dealing with the subject from rather a different standpoint.

† I beg to tender here my grateful thanks to Dr. Pressat and Dr. Camboulin of the Suez Canal Company for much information kindly supplied.

1. *El Ferdann.* Water was found at a depth of 2·50 metres, but it was salt.

2. *Saba'h 'Byar* (Seven Wells) in Wadi Tumilat.

3. *Bir Abu Balah.* Wells existed here from Biblical times. Six other pits dug gave only salt water.

4. *Lake Timsah.* Workmen were employed in cutting the reeds at the foot of the Nefisha sand-dunes, and the tamarisks bordering the lake, showing that the soil contained sufficient moisture to support vegetation.

5. *Fawar.* Passable water found at 3·30 metres. This was the site of an ancient pit.

6. *Tusum* (plateau). Abundant but slightly brackish water found at a depth of 13 metres. Previous to finding water here, it was conveyed by dromedary from Awebet Station, six hours' distance from Timsah.

1860-1861. Water in the centre of the Isthmus (Lake Timsah) was procured from wells sunk at the following places.

7. *Bir Abu Balah.* Water was found at a depth of 4·70 metres. This water was distributed by a water-wheel used for irrigating the attempts at cultivation of barley, cotton, melons, haricots, etc., over an area of 14,200 square metres. In October 6,400 square metres were ready to be sown. It is interesting to note, that at this time even, possibilities of pool formation existed, as very probably was the case with uncontrolled irrigation.

8. *Tusum.* Wells were dug, and near them a layer of clay, 1·20 metres thick, was found. A small garden, 30 by 20 metres, was planted with barley, wheat, bersim, cauliflowers, onions, haricots, sea-kale, etc.

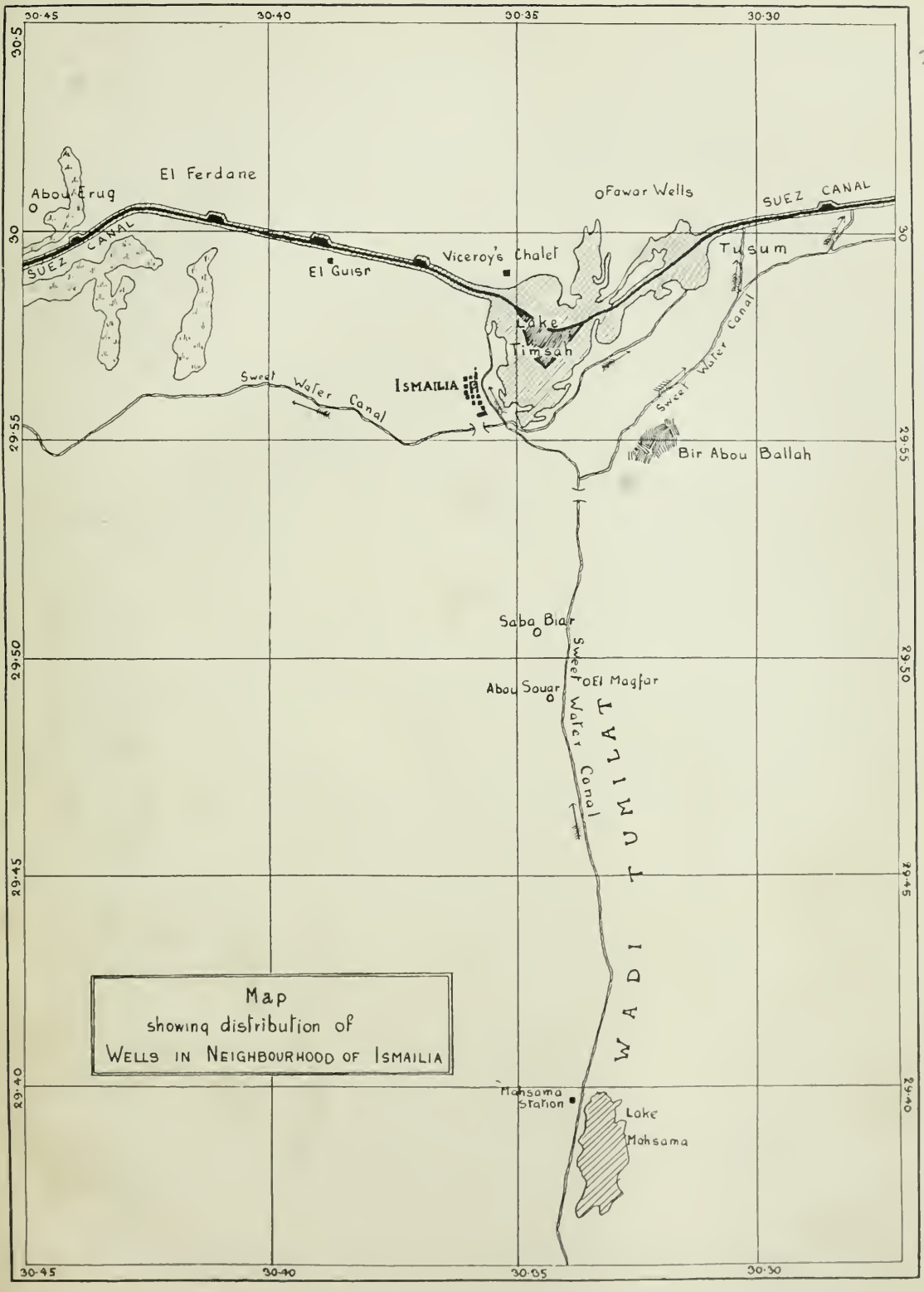
9. *Serapeum.* Water was found at a depth of about 17 metres.

10. *Abu Souer*, near Makfar, 15 miles from Seuil (El Guisr). These wells in the Wadi Tumilat Valley furnished excellent water.

11. *Nefisha.* Brackish but drunk by animals.

12. *Saba'h 'Byar.* Three miles from Makfar, close to Nefisha, gave sweet water. 'Excellent water throughout the year.' (Anonymous, 1857).

13. *Abu Erouq.* East of the Suez Canal, near Working-camp I, brackish but drunk by animals.


30·45
30·40
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30
29·55
29·50
29·45
29·40
El Ferdane
Abou Erug
SUEZ CANAL
El Guisr
Viceroy's Chalet
Fawar Wells
SUEZ CANAL
Tusum
Lake Timsah
ISMAILIA
Sweet Water Canal
Sweet Water Canal
Bir Abou Ballah
Saba Biar
Abou Sougar
El Magfar
Sweet Water Canal
WADI TUMILAT
Mahsama Station
Lake Mahsama
Map
showing distribution of
WELLS IN NEIGHBOURHOOD OF ISMAILIA

Alimentary Canal.

In order, however, to secure a more abundant supply of water for the working camp at El Guisr, about six miles north of Timsah (Ismailia), water was got from Lake Mahsama (average depth $\frac{2}{3}$ metre), in Wadi Tumilat.

A water-course, 26,800 metres long, 0·30 metres broad at bottom and 1 metre at water level, was constructed as far as Bir Abu Balah, where it was collected in a masonry reservoir. From here it was brought in pipes to Timsah (Ismailia) to a well and pumped up to a 64 square metre sheet-iron tank; from here, again, it was taken in earthenware pipes to El Guisr, where a second pump and reservoir was again used for distributing it as far as El Ferdann (about eight miles from Ismailia). The workmen digging this water-course got their water by camel from Nefisha. During a temporary failure of this supply, water was carried by camels from the sites (10-13) just mentioned.

Freshwater Canal

1862. Reached Timsah (Ismailia), and after the 23rd January was opened for navigation. It comprised (1) an old canal from Zagazig to Qassasin, and (2) a portion from Qassasin to Ismailia, 7·70 metres wide.

Sluices were constructed at Nefisha to carry off the excess of water into the lagoons bordering Lake Timsah. The difference of level between the freshwater canal and the Suez Canal was 6·6 metres, necessitating the intervention of locks.

1862. April 27. The first stones of the foundation of Ismailia (originally Timsah) were laid (though in 1862 two or three chalets had been begun), streets were laid out, palms planted. The population in September, 1862, was:—Europeans, 150; Arabs, 593.

(1863. Timsah called Ismailia.)

1865. A new canal in lieu of the old one built from Abassa to Qassasin, 10 metres wide.

1866. July. The canal termed the Ismailia Canal.

(1869. 17 November. Suez Canal opened.)

1870. The portion of the canal from Abassa to Qassasin enlarged to 13 metres.

1874. Portion from Qassasin to Ismailia enlarged from 7·70 metres to 13 metres (commenced).

1877. The new canal inaugurated, 15 April.

1896. Hydraulic rams used for distributing the water at Ismailia, previously it was done by the pumping station (*usine des eaux*) at Ismailia.

Circle Canal

1863. July-August. A pumping station was established at the extreme East of the town, to supply the stations between Ismailia and Port Said. This was supplied by a branch of the sweet-water canal, starting 720 metres above the upper lock at Ismailia. It was 2,670 metres long, and followed the North of the town, 0·5 metre wide at bottom, depth 0·75 metre. It furnished *water for the cultivations established along part of its course* and for a large *experimental garden* around the pumping station.

1866. It was cleaned.

1877. It was considerably enlarged at the same time that the Abassa-Ismailia Canal was replaced by one of larger section.

1880. It was filled up and dried.

These data are, I think, sufficient to show that breeding places existed from the earliest times, and that Anophelines also existed will be shown in the next section, hence I consider that the view of E. H. Ross (1909), that malaria came to Ismailia in 1877 with the enlarged freshwater canal, is incorrect.

II. ORIGIN OF MALARIA

1861. 'Among the numerous workmen employed at the construction of the freshwater canal, there occurred nine cases of simple intermittent fever which yielded easily to quinine. They had contracted the malady on the borders of Lake Mahsama, where the *fever showed itself each year, especially* after the rise of the Nile.' Voisin Bey (1906).

I conclude from this that malaria was, even at this time, endemic in the valley of the freshwater canal, and Anophelines also must have existed in the region.

1865. 'The town (Ismailia) was extensively watered by a system of pipes which conducted the water into each dwelling and permitted the establishment there of vegetable and flower gardens. The sanitary condition was normal in January, but in February ordinary illnesses began to take more grave forms, especially among the new arrivals—Calabrians, Dalmatians, Bretons and Greeks. Illnesses begun in Europe, and unknown in the works-stations on the Isthmus, showed themselves. Pernicious fevers, fever of a remittent type, etc., occurred. The mortality was 2·5 per cent.' Voisin Bey (1906).

1866. 'Among some work-stations, among others El Guisr (about three miles from Ismailia), cases of simple intermittent, and some cases of pernicious fever occurred. The Isthmus had, up to this time, been free from this malady, but this year the fevers had been fairly frequent, and had assumed the paludic character without being otherwise dangerous or obstinate. There was a kind of general paludic influence.' Voisin Bey (1906).

It seems clear from this that malaria was fairly common in the Isthmus, and that it is inconsistent to say that 'the Isthmus had, up to this time, been free from this malady.' We see thus early the seeds sewn of the crop which was eventually gathered in Ismailia.

After this date we have no further records, but it is hardly credible that no more malaria occurred until the outbreak in Ismailia in 1877. We believe rather that malaria was always endemic in the Lake Mahsama region, that malaria and Anophelines spread from there. Probably Anophelines were always present in the Nefisha lagoons as they were in 1908. (Three cases of malaria in 1905, Bulletin (1909), p. 8.) No doubt also many cases were European in origin.

1877. Epidemic. Pressat (1905), attributes the outbreak to the fact that the enlargement of the freshwater canal to 13 metres led to a superabundant water supply, which, filtering through the sand, formed a subterranean layer which formed pools at every suitable spot, that subsequently Anophelines were introduced by boats along the sweet-water canal, or by rail. The increase in water very likely led to more pools in this way, but pools and Anophelines must have existed long before this, as the freshwater canal reached Ismailia as early as 1862, and irrigation was proceeding in 1863,

and, moreover, the sub-soil water was always present, making itself apparent especially at high Nile, and, as a matter of fact, as we have just seen, malaria was recorded at Lake Mahsama in 1861, and at Ismailia itself in 1865. The data now available are, however, insufficient to explain, with certainty, why malaria, which we believe always to have been endemic at Ismailia, became epidemic in 1877 (300 cases). Nor, again, is the cause of the rise in 1886 (2,500 cases) explained.

III. THE ANTI-LARVAL OPERATIONS

Ismailia is situated on the North bank of Lake Timsah (Lake of Crocodiles). The lake received at rather high Niles fresh water (reaching it through the Valley of Gessen, roughly at right-angles to the Suez Canal, and through which region the present freshwater canal flows) according to an observer (Anon., 1857), who also states that he found the muddy sediment of the Nile in its swamps. Before the cutting of the Suez Canal, the water in it was intensely salt (owing to the underlying bed of salt); its depth was only 0·6 metre, but along its margin reeds grew in abundance and tamarisks (Anon., 1857) also occurred, deriving their nourishment (presumably) from the underlying sub-soil water.

Over a great part of the Isthmus, according to Roux (1901), one finds in the sub-soil a layer of water scarcely brackish, which is held in the sand by a thin layer of clay, and which flows about at the level of the sea and that of the Suez Canal.

Boyce (1904), notes: 'freshwater grasses, and other freshwater plants, growing along the margin of the canal, and even in the water of the canal itself, which is strongly salt. The explanation given to me of this occurrence was that the sub-soil fresh water in the bank of the canal afforded the necessary moisture for the roots.'

Ross (1903, p. 5), states that 'the sub-soil water is very near the surface and, as we are informed, fluctuates with the rise and fall of the distant Nile. In some spots near Ismailia, where the surface of the desert is much depressed, this sub-soil water produces considerable lakes and ponds, but owing to the extreme salinity of the sand most of these pools are brackish, their shores being encrusted with salt, supporting but little vegetation. There are

several spots, however, where the water is nearly, if not quite fresh, and here we observe a considerable amount of cultivation—grass and vegetation. There are even places where the fresh, natural waters produce shallow marshes of small extent; where small pools form among reeds and grass. And these can be found not only close to Ismailia but, as I was informed, in many parts of the desert, and can be seen along the railway to Cairo. But it must be understood that such areas are very small in extent when compared with the large surface of perfectly arid sand which surrounds the town.'

Breeding-Places of Anophelines and Anti-Larval Measures Adopted

Ross (1903, p. 12) says that 'whenever we examined the marshes connected with the natural waters which exist around Ismailia, we succeeded in finding numerous larvae of Anopheles and also of Culex. The insects existed especially among the short grass and other vegetation growing on soil covered with a very thin layer of water. On one series of pools situated to the East of the town, we found innumerable larvae both of Anopheles and Culex existing in water which was so brackish as to contain nine grams of salt per litre.'*

He sums up the breeding-places as follows:—

1. The small marshes in the midst of the cultivation to the East of the town (? Abu Rahan).

2. The still smaller marsh close to the abattoir. [(o) on map.]

3. A few were observed in an artificial fountain in the middle of the European station.

The following account is based on the data contained in (1) Pressat, 'Le Paludisme et les Moustiques' quoted as (P.) and (2) 'Suppression du Paludisme à Ismailia,' Compagnie universelle du Canal maritime de Suez, quoted as (S.), and on personal communications from Drs. Pressat and Cambouliu.

Pressat (p. 132) describes the Abu Rahan marshes as being infested with Anophelines, and that work was carried on there in

* These Anophelines may have been *Pyretophorus cleopatrae* Wilcocks, an Egyptian species which commonly breeds in saltish water, whereas *Cellia pharoensis* does not. Whether *P. chaudoyei*, an Algerian species, also exists in Egypt is, I think, doubtful.

'clouds of Anophelines' (p. 132). Elsewhere he describes the breeding places as being 'pools, drains, camel foot-prints in the environs of the town' (p. 129).

Abu Rahan Marsh.*

This marsh is situated to the North-east of the town, less than a mile (1,640 yards) away. It has an area of between nine and ten acres (44,252 square yards) and has an average depth at the portions marked A and B of four and a half feet and a maximum of about eight feet.

Presence of Larvae.

1901. August. Many were found in the irrigating channels that supplied the plantations of this marsh.

1902. September. Ross's data probably apply to this marsh.

Destructive measures.

1880-1881 or 1885. This marsh had been partly filled up in these years and planted with Casuarina, Eucalyptus and Palms. It had also been drained by a channel leading to the lake, but this drainage had been ineffective for a forest of reeds had grown over the whole of the Northern area. Moreover, at the rise of the Nile (in the Autumn) all the inequalities of the soil filled with water and especially the irrigating channels along the bases of the trees.

Note.—These preliminary efforts were made before the mosquito as the malaria agent was known.

1903. (*a*) The main drain was deepened and cleaned throughout so as to maintain a proper fall to the lake. The fall of the drain was 0·0005 per metre.

(*b*) Two encircling drains and three cross drains were constructed.

(*c*) Further, sluices were constructed so as to dam up the water, and subsequently to flush out the channels if necessary, but this has not been required.

(*d*) The reeds were cut everywhere.

(*e*) The soil was carefully levelled by filling up all depressions and all the irrigation channels.

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*I have been unable to ascertain when this marsh first came into existence.

Workmen were assigned to keep the drains at the proper depth and to keep their banks free from vegetation, and also to keep the marsh absolutely free from reeds.

Result.

1903. August. No larvae could be found either in the contributory channels or in the main drain. It must be noted that all these channels and the main drain contained fish, viz., *Mugil cephalus*, *M. capito* and *M. seheti* and also *Tilapia gallilea* (Arabic Chaba'r). Whether these fish destroy larvae is unknown, but *T. gallilea* will at least destroy them rapidly when hungry in an aquarium (P.).

The Subsidiary Marshes.

(1) Marsh H.

To the East of Abu Rahan is of slight depth.

Presence of larvae.

Along the margins there were numerous Anopheline pools.

Destructive measures.

It was filled up (with sand).

(2) Marsh I.

To the North-West of Abu Rahan, has an area of 22,962 square yards, equal to 4-5 acres, and a depth of about 2 feet 9 inches.

Presence of larvae.

No records.

Destructive measures.

It was filled up and united to the drains of Abu Rahan by a subterranean channel.

(3) Marshy Ground along Lemasson Avenue.

Pools formed during the rise of the Nile.

Presence of larvae.

No records.

Destructive measures.

1903. These had been filled up many years before, but they were now re-covered with a sufficiently thick layer of sand.

Southern Region.

Small depressions near the North bank of the lake, which contained water at high Nile.

Presence of larvae.

A few.

Destructive measures.

They were filled up with sand.

Western Region.

From the outskirts of the town to Nefisha Station, a distance of more than 5 kilometres (3 miles), exists a stretch of land lying between the sweet-water canal and the lake. The level of the sweet-water canal along this district is 6 metres (19 feet 8 inches) above the mean level of the lake. This land, like the rest of the desert when irrigated, is fertile and is let out to cultivators, but it is absolutely necessary for cultivation purposes that the water should not lie stagnant but be drained away. For this purpose the cultivators had constructed a number of canals but at the time of the anti-malaria campaign they were badly kept, full of weed and almost stagnant. We may consider these in more detail.

Western Region (N).

At this point there existed numerous small puddles and marshy areas covered with grass or bulrushes.

Presence of larvae.

Present, a dangerous focus (S. p. 15).

Destructive measures.

Filled in with sand.

Western Region (O, Q).

At the points O and Q hydraulic rams exist for the supply of water to the town and hospital respectively. The drains in connection with O led into the lake, while that of Q ran into Nefisha lagoon, an arm of the lake. Both were in a state of bad repair, the gradients were imperfect so that water remained stagnant in them, the banks had broken down, and water-cress beds had been established along their margins.

Presence of larvae.

Abundant, 'a dangerous focus' (S. p. 15). Ross also cites the marsh existing close to the Abattoir (O) as containing larvae.

Destructive measures.

The drains were cleaned, deepened, the banks repaired, the cress-beds done away with, all vegetation removed. The drain of hydraulic ram O was divided into branches, the eastern branch draining the neighbouring cultivated land.

CULTIVATED AREAS R, S, T, U.

The drains in these areas were exceedingly numerous.

Presence of larvae.

Abundant, 'a dangerous focus' (S. p. 15).

Destructive measures.

Numerous old drains were replaced by one large drain traversing a dune and discharging into Timsah. In other cases the drains were repaired, deepened and the banks kept in good order.

Result.

The result of these works on the cultivated lands was not at first satisfactory, for Anophelines still continued to breed in the gutters of the low-lying marshy parts opening into the lagoon, where the water was shallow and almost stagnant. Accordingly the plan was devised of damming (weekly) the irrigation water that supplied these areas. As the freshwater canal is about twenty feet above the lake level there is produced, on opening the dams, a very rapid and powerful stream, sufficient to sweep out all larvae. The result of this procedure was completely satisfactory. (This method of damming the water is now practised in all the irrigation channels. The water is led into those areas that require irrigation at definite intervals. It is then shut off, the result being that the water supplied to the area in question has all sunk into the ground in two or three days).

Result.

From the summer of 1903, no larvae found in the whole of the protected area* (S. p. 20).

* It is not clear whether the areas O, P, Q, R, S, T, U, were at this time included in in the term 'protected area' for in a letter Dr. Cambouliu informed me that the areas O, P, Q, R, S, T, U, were first drained in 1904-1905. In a subsequent letter, however, he states that 1903 is the correct date.

MARSH I.

This is situated to the West of Nefisha, is deep and contains several species of fish.

Presence of larvae.

None (Dr. Cambouliu).

Destructive (?) measures.

1906. Drainage commenced. Now completed, 1910.

MARSH V., SOUTH OF NEFISHA LAGOON.

Larvae.

Along the shore at the entrance of the drains. The drains contain numerous fish.

Measures.

1898. Levelled, planted and drained. 1903 (?), the pools containing larvae, filled with sand.

OTHER EXTENSIVE MARSHES.

Exist along the course of the sweet-water canal. They derive their water from the great drain, Bir Abu Balah, beyond Nefisha, but their drainage would be extremely costly.

ADULT ANOPHELINES.

Very few data exist as to their numbers in Ismailia, but it is stated (S. p. 11) that the whole town was invaded, and elsewhere (p. 16) that they appeared each year precisely in the autumn, but in regard to the first statement in a private communication Dr. Pressat states: 'certainement très peu parmi les grands quantités d'autres moustiques.'

In Abu Rahan marsh, adult mosquitos in large quantity (S. p. 15).

OILING OF POOLS.

Besides treating the culicine breeding grounds the brigade also oiled 'toutes les mares, rigoles, flaques d'eau, les pas de chameaus, des jardins et des alentours de la ville' (P. p. 134).

This, Dr. Pressat informed me, refers to the small collections of water in and around the town, and not to the marshes such as Abu Rahan.

Summary

As stated above, in August, 1903 (?1904, 1905), there were no larvae in the whole of the protected area, hence *ipso facto* from this time all fresh cases of malaria must have ceased, so that the anti-larval measures were a complete success. Apart from the drainage as a whole, I consider that the following three factors played an important part in achieving this success, viz.:—(1) Ismailia is in the desert; (2) the intermittent irrigation system with a fall of 20 feet from the freshwater to the maritime canal; (3) the presence of fish in all the drains.

Cost of the Operations

(1) *Initial expenses*, £2,000. This was incurred in filling up swamps and drainage (S. p. 25). Presumably this is up to 1906, the following data extend to 1909.

(2) The non-recurrent expenses incurred for filling up the pools and drainage of the swamps and arable lands situate in the neighbourhood of the town, and to which the Egyptian Government has contributed a part, to-day (1909) reach a total of about 100,000 francs (£4000). The area of the improved land represents about 400 hectares (roughly 1,000 acres), so that the cost was £4 an acre (Bulletin 1909).

(1) *Permanent expenses.* In keeping drains in good repair cutting reeds and flushing drains, £312 per annum. This does not include the sum spent in anti-Culicine work, which we have not considered here (S. p. 25). To this would also have to be added the expense of oiling small collections of water—possible Anopheline breeding places.

(2) The permanent expenses for disinfection, the hunt for mosquitos and larvae, and the maintenance of the improved lands have remained at about 18,000 francs (£720) per annum since 1903 (Bulletin 1909). This, no doubt, includes expenses of Culicine destruction, and accounts for the discrepancy between the two statements.

(3) The following table is added for the sake of completeness, though it does not appear that the expenses can be fairly put solely

to the account of anti-malarial measures. In fact, here, as in other figures, no details are given, and in this case it is impossible to say what proportion must be ascribed to each of the three headings.

Wages paid to fever patients whilst not working. Curative medicines distributed to old malaria patients. General prophylactic measures*.

TOTAL OF EXPENSES

1903	38,209	francs	£1,528	approximately
1904	25,986	,,	1,039	,,
1905	17,420	,,	696	,,
1906	16,963	,,	678	,,
1907	15,642	,,	625	,,
1908	16,806	,,	672	,,

IV. THE QUININE PROPHYLAXIS

1902. February. This was instituted at this time, '*à tout le personnel de la Compagnie* qui en a retiré un grand bénéfice' (P. p. 111), but I understand privately from Dr. Pressat that it was optional in the case of employés (about 2,000) and obligatory in the case of workmen (about 7,000). The latter, for example, if sick, lost a part of their salary, otherwise paid to them, unless they had taken their quinine in the fixed dose, in the presence of the overseers (S. p. 9). The Company, in fact, were in a position to ensure their orders being carried out.

Prophylactic dose.

This was given in the form of two pills of $1\frac{1}{2}$ grains each for three consecutive days, then a week's interval in the first half of the year, and a three day interval in the latter half of the year (the 'fever season') (S. p. 10).

* Ross (Bulletin 1909, p. 4) states 'I am informed that a considerable part of these expenses have been and are incurred not only for malaria prevention but also for agriculture and other purposes.' This is another illustration of the difficulty of finding out what exactly the published data connote.

Result.

As an example, it is stated (P. p. 106) that 'ces nombreuses équipes (centaines des ouvriers)' receiving daily, in this case, 3 grains of quinine, 'travaillèrent plusieurs mois,' in Abu Rahan marsh, 'dévoreés par les Anopheles et pas un des ouvriers ne prit la fièvre'; while, 'à lá même époque une compagnie particulière qui exécutait dans la même région des travaux de dragage sur le canal Abassieh, et qui ne prenait pas les mêmes précautions vit ses équipes litteralement fondre sur les atteintes de la malaria' (microscopically confirmed). Here it is not stated that these latter workmen were devoured by Anophelines, so that the difference might be attributed to their absence. If we are to assume that the first set of men were infected in the marsh then the mosquitos must have been infected there by gamete-carriers among the men, so that we get a *marsh* full of '*infected*' mosquitos. If such a condition existed it is an interesting and certainly an exceptional one, but it is, I think, more probable that these workmen, like the other gang, were infected in their houses, the difference between the two cases being the quinine prophylaxis.

It should be stated, however, that, according to Pressat (p. 132), Abu Rahan was formerly so unhealthy that one could not undertake the least work without redoubling the malaria. Elsewhere (P. p. 130) it is stated that circulars were issued. The employés and workmen were informed that there would be a daily gratuitous distribution of quinine. They were asked at the same time to suppress water in their 'bassins d'arrosage' and to suppress all stagnant water (P. p. 130).

Result.

This was appreciable, the number of malaria cases being:—

1901	1990
1902	1551

We have no data, however, as to what proportion of these cases were employés for whom the prophylaxis was optional.

Similarly in the dispensary we find a peculiar but more marked fall, the figures being:—

1900 ...	2,591	1903 ...	6
1901 ...	476	1904 ...	1 (first six months)
1902 ...	85		

From a private communication from Dr. Pressat I learn that in 1901 he began systematic blood examinations of the dispensary

patients, nearly all natives, so that the figure 476 may be accepted as accurate for 1901. We have then, in 1902, the great fall to 85. This fall is, I think, certainly due to the quinine prophylaxis of 1902 (for it was in December, 1902, that it was first decided systematically to undertake anti-larval measures after Major Ross's visit in September, 1902), for as we have seen the prophylaxis was compulsory on the labourers. (This fall must have had, too, some effect on the hospital statistics, for presumably some of these cases would become hospital patients.) To what the extraordinary fall of 2,591 in 1900 to 476 in 1901 is to be attributed is not clear. For although diagnosis made by the 'sisters' of the dispensary may not be very accurate, yet if these 2,591 cases of 'fever' were not malaria, we are at a loss to what to ascribe them, for, as Ross states, 'without it (malaria) Ismailia would be a settlement almost free from infectious diseases.' It should be added that quinine at this time was given by the 'sisters' to those who came to ask for it, but to what extent it was given, what effect it had it is impossible to say, unless one accepts these figures as affording the answer.

1903. The quinine prophylaxis was continued and in the pre-epidemic months the supervision was more strict. Circulars were issued explaining how to take it. It was distributed freely in the office, workshops and at the dispensary.

The following figures (P. p. 138), indicate to what extent the compulsory prophylaxis was carried out:—

QUININE PROPHYLAXIS.

1902 (9 months)	... 9,900 francs	...	£396
1903	... 14,780 ,,	...	591·2
1904	... 14,214 ,,	...	568·56

The following data differ again from these, but are official.

INTERNATIONAL CO-OPERATIVE PHARMACY AT ISMAILIA.
SALE OF QUININE.*

1902	... 16,905 fr. 10	... £656·20	approximately.
1903	... 15,678 fr. 20	... 627·12	,,
1904	... 11,624 fr. 17	... 464·96	,,
1905	... 6,482 fr. 46	... 259·28	,,
1906	... 6,689 fr. 90	... 267·56	,,
1907	... 8,821 fr. 96	... 352·84	,,
1908	... 5,927 fr. 44	... 237·08	,,

* Bulletin 1904, p. 9.

It is impossible then to estimate definitely the result of the quinine prophylaxis owing (1) to the incompleteness of the data, and (2) to the fact that in 1903 it was complicated by the anti-larval measures. We have, however, quoted some results that must be attributed to it. Whether malaria would have been stamped out at Ismailia by the quinine prophylaxis it is impossible to say. Had not anti-larval measures been adopted in 1903 then we would have had a quinine prophylactic experiment carried out under ideal conditions, and the result would have been of great scientific interest.

If, however, the Areas O, P, Q, R, S, T, U, were not drained till 1904-1905* it is probable that the decrease *in malaria* in 1903 was due in considerable part to the quinine prophylaxis, though the same result would have been arrived at without the taking of a grain of quinine.

NOTE.—The map is adapted from that published by the Suez Canal Company.

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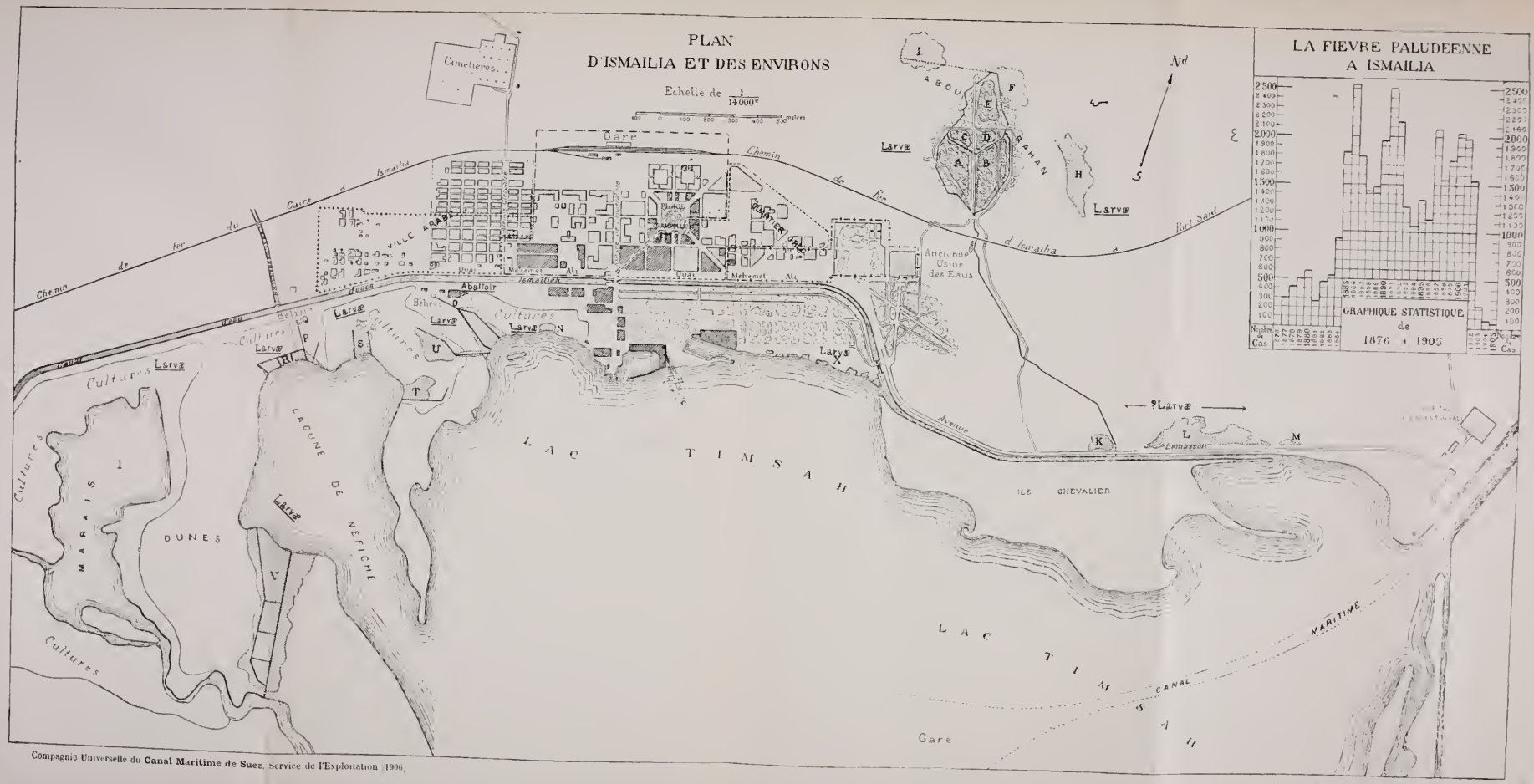
* *Vide* note antea.



Compagnie Universelle du **Canal Maritime de Suez**, Service de l'Exploitation (1906)

Note sur la *Suppression du Paludisme à Ismaïlia.*